

FORM PTO-1390 (REV. 5-93)		U.S. DEPARTMENT OF COMMERCE PATENT AND TRADEMARK OFFICE		ATTORNEY'S DOCKET NUMBER 10537/68	
TRANSMITTAL LETTER TO THE UNITED STATES DESIGNATED/ELECTED OFFICE (DO/EO/US) CONCERNING A FILING UNDER 35 U.S.C. 371				U.S. APPLICATION NO. (If known, see 37 CFR 1.5)	
				09/485074	
INTERNATIONAL APPLICATION NO. PCT/EP98/04659		INTERNATIONAL FILING DATE (24.07.98) 24 July 1998		PRIORITY DATES CLAIMED (02.08.97) 02 August 1997	
TITLE OF INVENTION <b>VIBRATION DAMPER FOR A TUBULAR DRIVE SHAFT</b>					
APPLICANT(S) FOR DO/EO/US LAUBLE, Christian; MOSER, Franz; SCHLIMPERT, Gunther; and FLINSPACH, Roland					
Applicants herewith submit to the United States Designated/Elected Office (DO/EO/US) the following items and other information					
<p>1. <input checked="" type="checkbox"/> This is a <b>FIRST</b> submission of items concerning a filing under 35 U.S.C. 371.</p> <p>2. <input type="checkbox"/> This is a <b>SECOND</b> or <b>SUBSEQUENT</b> submission of items concerning a filing under 35 U.S.C. 371.</p> <p>3. <input type="checkbox"/> This express request to begin national examination procedures (35 U.S.C. 371(f)) immediately rather than delay examination until the expiration of the applicable time limit set in 35 U.S.C. 371(b) and PCT Articles 22 and 39(1).</p> <p>4. <input checked="" type="checkbox"/> A proper Demand for International Preliminary Examination was made by the 19th month from the earliest claimed priority date.</p> <p>5. <input checked="" type="checkbox"/> A copy of the International Application as filed (35 U.S.C. 371(c)(2))</p> <p>a. <input type="checkbox"/> is transmitted herewith (required only if not transmitted by the International Bureau).</p> <p>b. <input checked="" type="checkbox"/> has been transmitted by the International Bureau.</p> <p>c. <input type="checkbox"/> is not required, as the application was filed in the United States Receiving Office (RO/US)</p> <p>6. <input checked="" type="checkbox"/> A translation of the International Application into English (35 U.S.C. 371(c)(2)).</p> <p>7. <input checked="" type="checkbox"/> Amendments to the claims of the International Application under PCT Article 19 (35 U.S.C. 371(c)(3))</p> <p>a. <input type="checkbox"/> are transmitted herewith (required only if not transmitted by the International Bureau).</p> <p>b. <input type="checkbox"/> have been transmitted by the International Bureau.</p> <p>c. <input type="checkbox"/> have not been made; however, the time limit for making such amendments has NOT expired.</p> <p>d. <input checked="" type="checkbox"/> have not been made and will not be made.</p> <p>8. <input type="checkbox"/> A translation of the amendments to the claims under PCT Article 19 (35 U.S.C. 371(c)(3)).</p> <p>9. <input checked="" type="checkbox"/> An oath or declaration of the inventor(s) (35 U.S.C. 371(c)(4)). (unexecuted)</p> <p>10. <input checked="" type="checkbox"/> A translation of the annexes to the International Preliminary Examination Report under PCT Article 36 (35 U.S.C. 371(c)(5)).</p>					
Items 11. to 16. below concern other document(s) or information included:					
<p>11. <input checked="" type="checkbox"/> An Information Disclosure Statement under 37 CFR 1.97 and 1.98.</p> <p>12. <input type="checkbox"/> An assignment document for recording. A separate cover sheet in compliance with 37 CFR 3.28 and 3.31 is included.</p> <p>13. <input checked="" type="checkbox"/> A <b>FIRST</b> preliminary amendment.</p> <p><input type="checkbox"/> A <b>SECOND</b> or <b>SUBSEQUENT</b> preliminary amendment.</p> <p>14. <input type="checkbox"/> A substitute specification.</p> <p>15. <input type="checkbox"/> A change of power of attorney and/or address letter.</p> <p>16. <input checked="" type="checkbox"/> Other items or information: International Search Report and English Translation thereof; Translation of International Preliminary Examination Report; three sheets of drawings; first page of published International Application WO 99/06730.</p>					

EXPRESS MAIL NO. : EL179957204US

U.S. APPLICATION NO. if known, see  
37 C.F.R. 1.5

09/485074

INTERNATIONAL APPLICATION NO

PCT/EP98/04659

ATTORNEY'S DOCKET NUMBER

10537/68

17. ☒ The following fees are submitted:**Basic National Fee (37 CFR 1.492(a)(1)-(5)):**

Search Report has been prepared by the EPO or JPO ..... \$840.00

International preliminary examination fee paid to USPTO (37 CFR 1.482) ... \$670.00

No international preliminary examination fee paid to USPTO (37 CFR 1.482) but  
international search fee paid to USPTO (37 CFR 1.445(a)(2)) ..... \$760.00Neither international preliminary examination fee (37 CFR 1.482) nor international  
search fee (37 CFR 1.445(a)(2)) paid to USPTO ..... \$970.00International preliminary examination fee paid to USPTO (37 CFR 1.482) and all  
claims satisfied provisions of PCT Article 33(2)-(4) ..... \$96.00

CALCULATIONS | PTO USE ONLY

**ENTER APPROPRIATE BASIC FEE AMOUNT =**

\$ 840.00

Surcharge of \$130.00 for furnishing the oath or declaration later than ☐ 20 ☐ 30 months  
from the earliest claimed priority date (37 CFR 1.492(e)).

\$

Claims

Number Filed

Number Extra

Rate

Total Claims

10 - 20 =

0

X \$18.00

Independent Claims

4 - 3 =

1

X \$78.00

78.00

Multiple dependent claim(s) (if applicable)

+ \$260.00

**TOTAL OF ABOVE CALCULATIONS =**

\$ 918.00

Reduction by 1/4 for filing by small entity, if applicable. Verified Small Entity statement must  
also be filed. (Note 37 CFR 1.9, 1.27, 1.28).

\$

**SUBTOTAL =**

\$ 918.00

Processing fee of \$130.00 for furnishing the English translation later the ☐ 20 ☐ 30  
months from the earliest claimed priority date (37 CFR 1.492(f)).

+

\$

**TOTAL NATIONAL FEE =**

\$ 918.00

Fee for recording the enclosed assignment (37 CFR 1.21(h)). The assignment must be  
accompanied by an appropriate cover sheet (37 CFR 3.28, 3.31). \$40.00 per property

+

\$

**TOTAL FEES ENCLOSED =**

\$ 918.00

Amount to be:  
refunded

\$

charged

\$918.00

- a. ☐ A check in the amount of \$\_\_\_\_\_ to cover the above fees is enclosed.
- b. ☒ Please charge my Deposit Account No. 11-0600 in the amount of \$ **918.00** to cover the above fees. A duplicate copy of this sheet is enclosed.
- c. ☒ The Commissioner is hereby authorized to charge any additional fees which may be required, or credit any overpayment to Deposit Account No. 11-0600. A duplicate copy of this sheet is enclosed.

**NOTE:** Where an appropriate time limit under 37 CFR 1.494 or 1.495 has not been met, a petition to revive (37 CFR 1.137(a) or (b)) must be filed and granted to restore the application to pending status.

SEND ALL CORRESPONDENCE TO:

SIGNATURE

Kenyon & Kenyon  
One Broadway  
New York, New York 10004Richard L. Mayer, Reg. No. 22,490

NAME

February 2, 2000

DATE

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

APPLICANT: LAUBLE ET AL.  
SERIAL NO.: to be assigned  
FILED: herewith  
TITLE: VIBRATION DAMPER FOR A TUBULAR DRIVE SHAFT  
ART UNIT: not yet known  
EXAMINER: not yet known

Assistant Commissioner for Patents  
Washington, D.C. 20231

Sir:

PRELIMINARY AMENDMENT

Please amend the above-identified application before a first consideration on the merits as follows:

IN THE TITLE:

Please amend the title to read --VIBRATION DAMPER FOR A TUBULAR PROPELLER SHAFT--

IN THE SPECIFICATION:

On page 1, before line 1, insert --Field of the Invention --.  
On page 1, line 1, before "invention" insert --present --.  
On page 1, before line 7, insert --Background of the Invention--.  
On page 1, line 7, change "36 32 418" to --No. DE 36 32 418--, and change "discloses" to --describes--.

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On page 1, line 9, change "known" to --described--.

On page 2, line 11, after "from" insert --United Kingdom Patent No.--.

On page 2, before line 17, line 24, insert --Summary of the Invention--.

On page 2, line 17, change "The underlying" to --An underlying--.

On page 2, line 21, delete "to be".

On page 2, line 22, change "is also intended to be" to --can also be--.

On page 2, line 26, delete "The object is achieved, inter alia, with the features of the principal claim.", and change "this" to --an exemplary embodiment of the present invention--.

On page 2, line 27, delete "vibration damper".

On page 3, line 21, after "In this" insert --embodiment of the present invention--.

On page 4, line 5, before "invention" insert --present--.

On page 4, line 6, change "embodiments:" to --embodiments.--.

On page 4, before line 8, insert --Brief Description of the Drawings--.

On page 4, line 8, change "the" to --a--.

On page 4, line 10, change "the" to --a--.

On page 4, line 12, change "is like" to --shows a vibration damper like that shown in--.

On page 4, line 14, change "is like" to --shows a vibration damper like that shown in-- and after "body," insert --and--

On page 4, line 16, change "is like" to --shows a vibration damper like that shown in--.

On page 4, before line 19, insert --Detailed Description of the Invention--.

On page 6, line 14, change "must" to --may--.

#### IN THE ABSTRACT:

Line 1, change "Abstract" to --Abstract of the Invention--.

Line 3, change "The invention relates to a" to --A--.

Delete lines 12 - 14.

#### IN THE CLAIMS:

Please cancel without prejudice original claims 1-6 and the substitute claims 1-8 annexed to the International Preliminary Examination Report, and add new claims 9-18 as follows:

9. (new) A vibration damper for a tubular propeller shaft in the drive train of a motor vehicle, the vibration damper comprising:

- a sleeve, the sleeve defining a radial and circumferential direction;
- a mass body mounted concentrically in the sleeve;
- a plurality of rubber spring elements for mounting the mass body to the sleeve; and
- a plurality of flexible stop elements disposed circumferentially between the spring elements and disposed between the mass body and the sleeve for limiting a vibration travel of the mass body at least in the radial direction, wherein the stop elements extend over a larger circumferential angle than the spring elements and occupy a large portion of a space between the mass body, the spring elements and the sleeve.

10. (new) The vibration damper as recited in claim 9 wherein the flexible stop elements include rubber.

11. (new) A vibration damper for a tubular propeller shaft in the drive train of a motor vehicle, the vibration damper comprising:

- a sleeve, the sleeve defining a radial and circumferential direction;
- a mass body mounted concentrically in the sleeve; and
- a plurality of rubber spring elements for mounting the mass body to the sleeve; wherein at least one of the mass body and the sleeve at least partially form, in circumferentially opposite regions between the rubber spring elements, a plurality of stop elements for limiting a vibration travel of the mass body in at least the radial direction, wherein the stop elements extend over a larger circumferential angle than the spring elements.

12. (new) The vibration damper as recited in claim 11 wherein the flexible stop elements include rubber.

13. (new) The vibration damper as recited in claim 11 wherein the sleeve includes an undulating longitudinal profile having troughs, the spring elements being arranged at the troughs, and at least a portion of the troughs serving as at least a portion of the stop elements.

14. (new) The vibration damper as recited in claim 9 further comprising a propeller shaft mounted concentrically with the sleeve and wherein the sleeve includes a first and a second tube segment joined together, the first tube segment having a greater outside diameter than an outside diameter of the second tube segment and corresponding approximately to an inside diameter of the propeller shaft, the second tube segment carrying on an outer contour the mass body, at least one of the plurality of spring elements connecting the second tube segment to the mass body, the mass body being annular at least in an area of connection with the second tube segment.

15. (new) The vibration damper as defined in claim 9 wherein the sleeve further defines an axial direction and wherein the mass body is mounted axially between at least two of the plurality of spring elements and the sleeve fits axially around the mass body.

16. (new) The vibration damper as defined in Claim 15, wherein the sleeve includes a tubular segment having two sides and two end faces, planar, disk-shaped regions being included at both end faces, the plurality of spring elements being attached to the disk-shaped regions.

17. (new) A vibration damper for a tubular propeller shaft in the drive train of a motor vehicle, the vibration damper comprising:

- a propeller shaft, the propeller shaft defining a radial and a circumferential direction;
- a mass body arranged concentrically in the propeller shaft;
- a plurality of rubber spring elements for mounting the mass body to the propeller

shaft; and

a plurality of stop elements for limiting a vibration travel of the mass body at least in the radial direction, the stop elements being disposed between the mass body and the propeller shaft and circumferentially between the rubber spring elements, the stop elements including at least one of metal or rubber.

18. (new) A vibration damper for a tubular propeller shaft in the drive train of a motor vehicle, the vibration damper comprising:

a propeller shaft defining a radial and a circumferential direction;  
a mass body arranged concentrically in the propeller shaft; and  
a plurality of rubber spring elements for mounting the mass body to the propeller shaft;

wherein at least one of the mass body and the propeller shaft at least partially form, in circumferentially opposite regions between the rubber spring elements, a plurality of stop elements for limiting a vibration travel of the mass body in at least the radial direction.--.

#### REMARKS

This Preliminary Amendment cancels original claims 1-6 and substitute claims 1-8 annexed to the International Preliminary Examination Report in the underlying PCT Application No. PCT/EP98/04659 (a translation of which is submitted herewith), and adds new claims 9-18. The new claims do not add new matter to the application but do conform the claims to U.S. Patent and Trademark Office rules.

The amendments to the specification and abstract are to conform the specification and abstract to U.S. Patent and Trademark Office rules. It is respectfully submitted that the amendments to the specification and abstract do not introduce new matter into the application.

The underlying PCT application includes a Search Report, a copy of which is submitted herewith.

#### Conclusion

Consideration of the present application as amended is hereby respectfully requested.

Respectfully Submitted,

Kenyon & Kenyon

Dated: 2/2/00

By: 

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31/PRTS

09/485074  
430 Rec'd PCT/PTO 02 FEB 2000

[10537/68]

Vibration Damper For a Tubular Drive Shaft

The invention relates to a vibration damper for a tubular propeller shaft in the drive train of a motor vehicle having a mass body mounted concentrically in a sleeve by way of rubber spring elements, stop elements that limit the vibration travel of the mass body at least in the radial direction being arranged between the mass body and the sleeve.

German Patent 36 32 418 on the one hand discloses a vibration damper whose mass body is attached directly in a hollow drive shaft by way of a rubber spring element which envelops it radially. Also known is a second vibration damper whose mass body is mounted in a sleeve by way of a rubber spring element which also envelops it. The sleeve is embedded in an elastic layer.

The vibration dampers described here, also called cancelers, are installed principally in propeller shafts or propeller shaft tubes. The propeller shaft tubes are loaded on the one hand in torsion by the drive torque, and on the other hand in bending by their own weight and by the mass effect. They must therefore be not only sufficiently stiff in torsion, but also as light as possible. In order for the vibration dampers with their mass bodies to increase the overall weight of the propeller shaft tube as little as possible, the vibration dampers must be capable of being arranged at the optimum point. That point is, for example, the vibration crest of an interfering vibration that is to be canceled.

At the optimum point, the weight of the mass body can have its minimal value.

Since each propeller shaft, as a flexurally elastic rotor, generally exhibits some imbalance as a result, inter alia, of manufacturing tolerances, the centrifugal force also increases with rotation speed. The propeller shaft thus deflects in the direction of the

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eccentricity of its center of gravity. In the lower range of rotation speeds usual for propeller shafts, the propeller shaft deflection initially rises in proportion to the centrifugal force component, which is related only to the eccentricity in the center of gravity because the centrifugal force component related to the shaft deflection is still small. Above half the deflection-critical rotation speed, the shaft deflection component quickly increases to a multiple of the component of the eccentricity of the center of gravity. In this range, the known rubber-sprung mass bodies can dangerously amplify the imbalance of the entire structure due to an eccentric displacement in the direction of the eccentricity in center of gravity of the propeller shaft.

Also known, from GB 2 073 363 A, is a printing roller in which a rubber-sprung mass body is mounted. For this purpose, the mass body is arranged by way of two rubber rings in a sleeve press-fit into the printing roller. The rubber rings sit at the two free ends of the mass body. Arranged next to each rubber ring is a metal ring which limits the radial deflection of the mass body.

The underlying object of the present invention is therefore that of creating a vibration damper that effectively damps the flexural vibrations of the propeller shaft for specific frequencies without perceptibly increasing the imbalance of the propeller shaft - and thus also the noise emission - in other frequency ranges. As a result of its design, the vibration damper is to be installable at any desired point with little effort. The installation of multiple vibration dampers is also intended to be possible. In addition, safe vehicle operation is to be guaranteed even in the event of detachment or breakage of the rubber spring elements retaining the mass body.

The object is achieved, inter alia, with the features of the principal claim. In this vibration damper the flexible rubber stop elements are arranged - viewed in the circumferential direction - between the rubber spring elements joining the mass body and the sleeve. The stop elements extend over a relatively large circumferential angle as compared with the rubber spring elements, and fill up a large portion of the space

located between the mass body, the adjacent rubber spring elements, and the sleeve. Alternatively, the mass body and/or the sleeve are configured locally, in mutually opposite regions - viewed in the circumferential direction - between the rubber spring elements, as stop elements that limit the vibration travel of the mass body at least in the radial direction.

The stop elements limit the mass body excursion to the magnitude necessary in terms of vibration engineering. The vibration dampers damp the vibration excited by the vehicle engine and/or transmission. At the same time, the stop elements prevent any perceptible increase in the total imbalance by mechanically limiting the displacement of the mass body. The noise emission of the drive train is thereby considerably diminished.

The stop elements between the rubber spring elements also prevent any increased imbalance if, for example, the rubber spring elements have broken due to aging and the mass body lies loose in the propeller shaft tube. Without the stop elements, the imbalance additionally generated by the mass body could, in this situation, destroy the propeller shaft.

This also applies to a vibration damper having a mass body arranged in the propeller shaft by way of at least one rubber spring element. In this, the flexible rubber stop elements are arranged directly between the mass body and the propeller shaft. Here again, the mass body and/or the propeller shaft can be configured locally, in mutually opposite regions - viewed in the circumferential direction - between the rubber stop elements, as stop elements that limit the vibration travel of the mass body at least in the radial direction.

With this embodiment, the rubber spring elements are not braced via a sleeve against the propeller shaft tube. They are adhesively bonded, optionally with a profile to compensate for the bore tolerances of the propeller shaft tube, in the propeller shaft

tube. For that purpose, the rubber spring elements and/or stop elements are coated with, for example, an adhesive that bonds in the propeller shaft tube when its walls are heated.

Further details of the invention are evident from the descriptions below of several schematically depicted embodiments:

Figure 1 shows the vibration damper in a quartered cross section;

Figure 2 shows the vibration damper in a halved longitudinal section;

Figure 3 is like Figure 2, but with radial stops;

Figure 4 is like Figure 2, but with an external mass body;

Figure 5 is like Figure 2, but with rubber spring elements located on either side of the mass body.

Figure 1 shows, in cross section, four different exemplary embodiments of a vibration damper for a propeller shaft tube 1 such as is arranged, for example, in the drive train of a motor vehicle. The four vibration dampers each comprise a mass body 51-53 that is mounted centeredly via rubber spring elements 31, 32 in a sleeve 10, 15. The bonds between rubber spring elements 31, 32 and the respective sleeves 10, 15 as well as the mass bodies 51-53 belonging thereto are preferably created during vulcanization.

In the case of the exemplary embodiments of the first two quadrants I and II, sleeves 10 are of cylindrical configuration. Mass body 51 is a cylindrical tube. It is retained, for example, by four rubber spring elements 31 in each case. Arranged between each two supporting rubber spring elements 31 is a flexible rubber stop element 41. Stop element 41 of the exemplary embodiment in quadrant I is attached to mass body 51,

while stop element 42 of the exemplary embodiment in quadrant II is retained on sleeve 10. In this case any lateral movement of mass body 51 is prevented, for example, by a crimped-over sleeve edge.

5 Stop elements 41, 42 extend over a relatively large circumferential angle as compared to rubber spring elements 31, 32, i.e. they fill up a large portion of space 45 located between mass body 51, the adjacent rubber spring elements 41, and sleeve 10. As a result, the vibration travel in the central compression direction of a rubber spring element 31, 32 is only insignificantly greater than in the central compression direction of a stop element 41, 42.

10 Space 45 between each two adjacent rubber elements 31 has an almost circular cross section. The shape of rubber elements 31 resulting therefrom ensures an optimum bond with respect to metal components 10 and 51.

15 In quadrants III and IV, a sleeve 15 having an undulating longitudinal profile is used. The longitudinal sections with respect to the profile shown here in cross section run parallel to the center line of propeller shaft tube 1. Because of the undulating shape of the profile, sleeve 15 is at least sufficiently elastic that it can be pressed without fit problems into propeller shaft tube 1. The residual clamping force of sleeve 15 necessary for a secure fit in propeller shaft tube 1 is ensured over the entire tolerance range for the inside diameter of propeller shaft tube 1. It is consequently possible to dispense with any special reworking of inner wall 2 of propeller shaft tube 1.

20 In quadrant III, there lies between rubber spring elements 32 a stop element 43, attached to mass body 52, that is at least partially adapted to the contour of an undulation trough 16. This adaptation allows damping of the torsional vibration of mass body 52. A rotation of mass body 52 with respect to sleeve 15 causes a reduction in the gap between stop element 43 and undulation trough 16, optionally to zero.

In quadrant IV, a mass body 53 that has the cross section of a four-sided polygon is used. The exposed polygon regions lie opposite the open undulation troughs 16 of sleeve 15. To prevent any metal-to-metal contact between sleeve 15 and mass body 53, a thin rubber layer 44 or a layer of a comparable material is applied in each case between rubber spring elements 32. Rubber layer 44 prevents, inter alia, undesirable noise when mass body 53 abruptly deflects, and additionally damps any vibratory excitation resulting from this movement.

Figure 2 shows a vibration damper having a cylindrical sleeve 10, a tubular mass body 51, and one of rubber spring elements 31 lying therebetween. The latter are narrower in the longitudinal direction than sleeve 10. The projection of sleeve 10 serves, inter alia, to protect the rubber spring and stop elements 31, 41, 42 during installation. Since the vibration dampers are installed by inserting sleeves 10 into propeller shaft tube 1, the insertion tools must be placed against sleeve 10 so as thereby not to load rubber spring elements 31 upon insertion.

For axial retention, the vibration damper can be attached to the laterally projecting segments. for example, by way of spot welds on propeller shaft tube 1. Optionally, attachment to one projecting segment is sufficient. Alternatively, sleeve 10, 15 can be secured by way of center points punched into propeller shaft tube 1 in front of and behind it. Instead of the center points, circumferential creases can be rolled in. The creases can also be applied only to portions of the sleeve circumference. It is furthermore possible to apply the vibration damper on one side to a shoulder in the interior of the propeller shaft tube, or to jam the sleeve in place on an internal conicity which tapers there. The sleeve can moreover be adhered in the propeller shaft tube by way of an adhesive bond.

In the case of propeller shaft tubes having a tube wall manufactured with high precision, the sleeve can be joined by way of a transverse press fit. In tubes having large bore tolerances, a longitudinally slotted sleeve can be used. In this context, a

smooth or profiled rubber coating of the outer contour is also conceivable in order to produce better adhesion.

As shown in Figure 3, rubber spring element 33 is incorporated between a mass body 52 delimited by rims 55, 56 and a sleeve 10 having a crimped edge 11. Rims 55, 56 and crimped edge 11 serve as radial stops. Upon radial deflection of mass body 52, rim 55 comes into contact with crimped edge 11, and rim 56 with the projecting cylindrical segment 12. The contact zones can be covered with an elastic coating.

Figure 4 shows a vibration damper having a stepped sleeve 21. The segment with the greater diameter is the installation segment 22. By way of this segment, the vibration damper is retained in propeller shaft tube 1. The segment with the smaller diameter is support segment 23. On the latter, rubber spring elements 31 carrying mass body 51 are arranged. Present between mass body 51 (which in this case is cylindrical) and inner wall 2 of propeller shaft tube 1 is a narrow gap whose width corresponds to half the maximum excursion of mass body 51. In the event of an imbalanced rotation of propeller shaft tube 1, mass body 51 conforms to inner wall 2 over a large contact zone. Mass body 51 is optionally coated on its external periphery with an elastic material.

Mass body 51 can also have the cross-sectional shape of a cup, so that it fits around carrier segment 23 of sleeve 21 (cf. cross-hatched widening of mass body 51). In addition, the mass body can have, for example, a cylindrical extension 59 at base 58 of the cup. Said extension 59 would lie concentrically inside the external tubular segment 57 of mass body 51.

A second vibration damper having a configuration described in one of Figures 1 through 3 and 5 can furthermore be arranged in support segment 23.

Figure 5 shows a vibration damper whose rubber spring elements 34, 35 are loaded

primarily in shear in the event of a radial deflection of mass body 51. This stress, which is favorable for the metal/rubber bond, is made possible by a sleeve 25 that is delimited at its end faces by, for example, planar disks 26, 27; a rubber spring element 34, 35 is arranged between each disk 26, 27 and mass body 51. Rubber spring elements 34, 35 are embodied here, for example, as continuous rings. Mass body 51, for example of tubular configuration, can carry a coating 44 on its external contour. In the exemplary embodiment, sleeve 25 is embodied as a bushing that is closed off by a spot-welded cover 27.

The central bore of the vibration damper facilitates manufacture, but is not absolutely necessary. Mass body 51 can optionally be widened, as illustrated in Figure 5 with cross-hatching.

Such widenings (cf. also Figure 4) have the advantage that the mass of the respective mass body 51-53 can be modified, with no change in the design of sleeves 21-25, in order to adapt the vibration behavior of the vibration damper to specific interference frequencies of different propeller shaft tubes 1 having the same inside diameter.

Regardless of the location at which stop elements 41-43 are attached, the radial clearance of the individual mass bodies 51-53 in the corresponding sleeves or with respect to inner wall 2 of propeller shaft tube 1 is, for example, approximately 0.5 to 1 mm in terms of the inner radius of the sleeve or propeller shaft tube. Depending on the vibration behavior of propeller shaft tube 1, the gap can have a defined dimension. As a rule, higher interference frequencies will require smaller gaps to prevent the imbalance of the combination of propeller shaft tube 1 and mass body 51-53 from becoming too great.

## New Claims

1. A vibration damper for a tubular propeller shaft in the drive train of a motor vehicle having a mass body mounted concentrically in a sleeve by way of rubber spring elements, stop elements that limit the vibration travel of the mass body at least in the radial direction being arranged between the mass body and the sleeve, characterized in that
  - flexible rubber stop elements (41, 42) are arranged - viewed in the circumferential direction - between the rubber spring elements (31) joining the mass body (51) and the sleeve (10), the stop elements (41, 42) extending over a relatively large circumferential angle as compared with the rubber spring elements (31) and filling up a large portion of the space (45) located between the mass body, the adjacent rubber spring elements (41, 42), and the sleeve (10).
2. A vibration damper for a tubular propeller shaft in the drive train of a motor vehicle having a mass body mounted concentrically in a sleeve by way of rubber spring elements, stop elements that limit the vibration travel of the mass body at least in the radial direction being arranged between the mass body and the sleeve, characterized in that
  - flexible rubber stop elements (43, 44) are arranged - viewed in the circumferential direction - between the rubber spring elements (32) joining the mass body (53, 53) (**sic**) and the sleeve (16), the stop elements (43, 44) extending over a relatively large circumferential angle as compared with the rubber



spring elements (32); and that

- the mass body (51-53) and/or the sleeve (21-25) are configured locally [section by section], in mutually opposite regions - viewed in the circumferential direction - between the rubber spring elements (32, 43, 44), as stop elements (16) that limit the vibration travel of the mass body (52, 53) at least in the radial direction.

3. The vibration damper as defined in Claim 2, characterized in that the sleeve (15) has an undulating longitudinal profile, the rubber spring elements (32) being arranged in the undulation troughs (16) of the longitudinal profile, while at least a portion of the remaining undulation troughs (16) serve as stop regions.
4. The vibration damper as defined in Claim 1 or 2, characterized in that a sleeve (21) comprises two tube segments (22, 23) of different outside diameters joined to one another, the tube segment (22) having the greater outside diameter corresponding approximately to the inside diameter of the propeller shaft (1), while the tube segment (23) having the smaller outside diameter carries on its outer contour, by way of at least one rubber spring element (31), an at least locally annular mass body (51).
5. The vibration damper as defined in Claim 1 or 2, characterized in that a sleeve (25) fits in the axial direction around a mass body (51) mounted axially between at least two rubber spring elements (34, 35).

6. The vibration damper as defined in Claim 5, characterized in that the sleeve (25) has a tubular segment that transitions on both sides at its end faces into planar, disk-shaped regions (26, 27) to which the rubber spring elements (34, 35) are attached.
7. A vibration damper for a tubular propeller shaft in the drive train of a motor vehicle having a mass body arranged concentrically in the propeller shaft by way of rubber spring elements, characterized in that
- metal and/or flexible rubber stop elements that limit the vibration travel of the mass body at least in the radial direction are arranged between the mass body and the propeller shaft, the stop elements being arranged - viewed in the circumferential direction - between the rubber spring elements.
8. A vibration damper for a tubular propeller shaft in the drive train of a motor vehicle having a mass body arranged concentrically in the propeller shaft by way of rubber spring elements, characterized in that
- the mass body and/or the propeller shaft are configured locally, in mutually opposite regions - viewed in the circumferential direction - between the rubber stop elements, as stop elements that limit the vibration travel of the mass body at least in the radial direction.

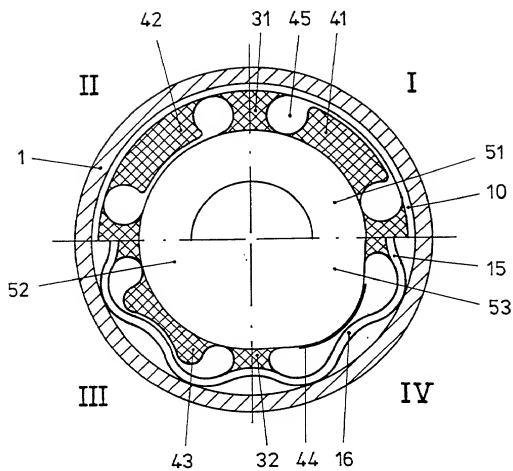
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## Abstract

The invention relates to a vibration damper for a tubular propeller shaft in the drive train of a motor vehicle having a mass body mounted concentrically, in the propeller shaft or in a sleeve attached in the propeller shaft, by way of at least one rubber spring element. Metal and/or flexible rubber stop elements that limit the vibration travel of the mass body at least in the radial direction are arranged between the mass body and the sleeve. Alternatively, the mass body and/or the sleeve are configured at least locally, in mutually opposite regions, as stop elements that limit the vibration travel of the mass body at least in the radial direction.

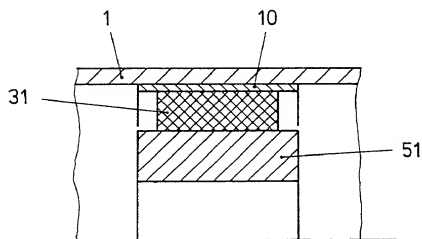
What is created with the invention is a vibration damper that effectively damps the flexural vibrations of the propeller shaft for specific frequencies without perceptibly increasing the imbalance of the propeller shaft in other frequency ranges.

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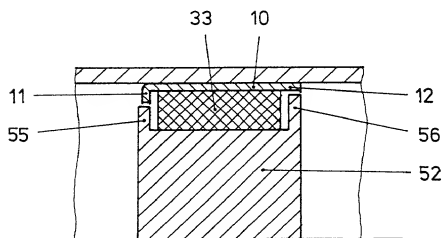


Figur 1

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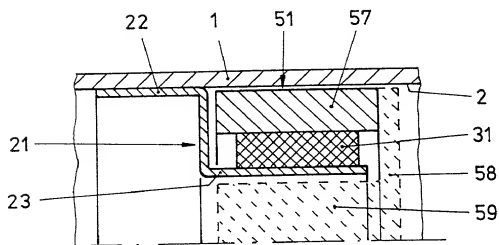


Figur 2

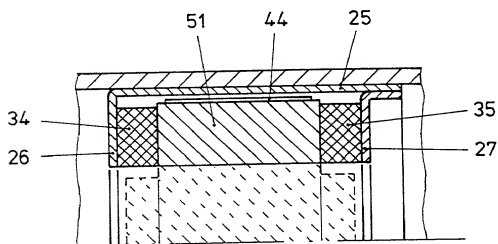


Figur 3

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Figur 4



Figur 5

DECLARATION AND POWER OF ATTORNEY

As below named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below next to my name.

I believe I am an original, first and joint inventor of the subject matter that is claimed and for which a patent is sought on the invention entitled **VIBRATION DAMPER FOR A TUBULAR DRIVE SHAFT**, the specification of which was filed as International Application No. PCT/EP98/04659, on July 24, 1998, a translation of which is attached hereto.

I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims.

I acknowledge the duty to disclose information that is material to the examination of this application in accordance with Title 37, Code of Federal Regulations, §1.56(a).

I hereby claim foreign priority benefits under Title 35, United States Code, § 119 of any foreign application(s) for patent or inventor's certificate listed below and have also identified below any foreign application for patent or inventor's certificate filed by me on the same subject matter having a filing date before that of the application on which priority is claimed:

PRIOR FOREIGN APPLICATION(S)

(Number)	(Country)	(Day/month/year filed)	Priority Claimed Under 35 USC 119
197 33 478.4	Fed. Rep. of Germany	02 August 1997	Yes <u>X</u> No <u>  </u>

And I hereby appoint Richard L. Mayer (Registration No. 22,490), Gerard A. Messina (Registration No. 35,952) and Erik Swanson (Registration No. 40,833) my attorneys with full power of substitution and revocation, to prosecute this application and to transact all business in the Patent and Trademark Office connected therewith.

EL327548315US

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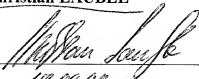
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I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

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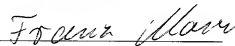
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